

Serial No.: 10/623,674

Docket No.: GMC0044PA/40320.48/GP-303298

Amendments to the Claims

1. (Currently amended) A fuel processor based fuel cell system comprising:
 - a primary reactor adapted to generate a gaseous reformat from feed inputs comprising steam;
 - a high temperature proton exchange membrane fuel cell (HT-PEMFC) stack in fluid communication with the primary reactor, said HT-PEMFC stack is adapted to receive the gaseous reformat for generating electrical power and to generate the steam needed for the primary reactor;
 - a compressor adapted to provide compressed air to the HT-PEMFC stack;
 - an anode exhaust condenser and a cathode exhaust condenser adapted to receive heat energy from a respective exhaust from the HT-PEMFC and to heat air used by the compressor; and
 - a stack excess steam condenser, wherein the air is also used to condense a portion of the steam provided to the excess steam condenser before being fed to the compressor.
2. (Original) A fuel processor based fuel cell system according to claim 1 wherein the feed inputs further comprises air, a hydrogen-containing fuel, and combinations thereof.
3. (Original) A fuel processor based fuel cell system according to claim 1 further comprising a water gas shift (WGS) reactor in fluid communication between the primary reactor and the HT-PEMFC stack, and a primary reactor heat exchanger in fluid communication between the primary reactor and the WGS reactor to heat at least the

Serial No.: 10/623,674

Docket No.: GMC0044PA/40320.48/GP-303298

steam before being used in the primary reactor with heat energy from the gaseous reformat.

4. (Original) A fuel processor based fuel cell system according to claim 1 further comprising a catalytic combustor in fluid communication with a superheat heat exchanger to heat at least the steam before being used in the primary reactor with heat energy from the catalytic combustor.
5. (Original) A fuel processor based fuel cell system according to claim 1 further comprising a WGS reactor heat exchanger provided in fluid communication between a WGS reactor and the HT-PEMFC stack, the WGS reactor heat exchanger is adapted to heat the steam before being used in the primary reactor with heat energy from the gaseous reformat.
6. (Original) A fuel processor based fuel cell system according to claim 1 wherein the primary reactor is selected from the group consisting of an auto-thermal reactor and a steam reformer.
7. (Original) A fuel processor based fuel cell system according to claim 1 further comprising a stack excess steam condenser, and wherein a portion of about two-thirds to about one-half of vaporized water in the steam is recondensed in the stack excess steam condenser and recycled to the HT-PEMFC stack for cooling needs.

Serial No.: 10/623,674

Docket No.: GMC0044PA/40320.48/GP-303298

8. (Original) A fuel processor based fuel cell system according to claim 1 wherein a portion of about one-third to one-half of vaporized water in the steam is used in the primary reactor.
9. (Original) A fuel processor based fuel cell system according to claim 1 further comprising a catalytic combustor, and wherein excess hydrogen unconsumed by the HT-PEMFC stack in a catalyst reaction using the gaseous reformat is fed into the catalytic combustor to maintain a temperature required for producing the gaseous reformat in the primary reactor.
10. (Original) A fuel processor based fuel cell system according to claim 1 further comprising a catalytic combustor in fluid communication with a combustor air preheat heat exchanger which is adapted to receive heat energy from combustor exhaust and to preheat air used in the catalytic combustor.
11. (Original) A fuel processor based fuel cell system according to claim 1 further comprising anode and cathode exhaust liquid separators adapted to recover water from anode and cathode exhausts from the HT-PEMFC stack.
12. (Original) A fuel processor based fuel cell system according to claim 1 further comprising a stack coolant liquid separator to separate liquid water from the steam exiting the HT-PEMFC stack.

Serial No.: 10/623,674

Docket No.: GMC0044PA/40320.48/GP-303298

13. (Canceled)
14. (Canceled)
15. (Original) A fuel processor based fuel cell system according to claim 1 further comprising an anode exhaust preheat heat exchanger receiving anode exhaust from the HT-PEMFC stack and a bypass circuit used to divert the gaseous reformat into the anode exhaust preheat heat exchanger to provide greater heat input to the anode exhaust before sending the gaseous reformat to the HT-PEMFC stack.
16. (Currently amended) A fuel processor based fuel cell system according to claim 1 wherein the ~~primary reactor~~ HT-PEMFC stack has an anode stoichiometry from about 1.0 to about 1.3, ~~and preferably from about 1.1 and about 1.2.~~
17. (Original) A fuel processor based fuel cell system according to claim 1 wherein the primary reactor uses a ratio of steam to fuel carbon (S:C) from about 2 to about 5.
18. (Currently amended) A fuel processor based fuel cell system according to claim 1 wherein the primary reactor uses a ratio of atomic oxygen in air flow to carbon in fuel flow (O:C) from about 0.6 to about 1.5, ~~and preferably from about 0.75 to about 0.8.~~
19. (Canceled)

Serial No.: 10/623,674

Docket No.: GMC0044PA/40320.48/GP-303298

20. (Original) A fuel processor based fuel cell system according to claim 1 further comprising a water/steam separator to remove excess water contained in the gaseous reformat before being fed to the HT-PEMFC stack.
21. (Currently amended) A fuel processor based fuel cell system comprising:
- a reactant stream comprising steam;
 - a primary reactor adapted to generate a gaseous reformat using the reactant stream;
 - a primary reactor heat exchanger in fluid communication with the primary reactor to preheat the reactant stream;
 - a high temperature proton exchange membrane fuel cell (HT-PEMFC) stack adapted to receive the gaseous reformat for generating electrical power, the HT-PEMFC stack being cooled by water and the steam being provided via water vaporization of the water in the HT-PEMFC stack;
 - a catalytic combustor; and
 - a superheat heat exchanger adapted to receive heat energy from the catalytic combustor to ~~superheat provide additional preheating to the reactant stream, the~~ superheated reactant stream is then combined with compressed air before being used in the primary reactor.
22. (Original) A fuel processor based fuel cell system according to claim 21 wherein the reactant stream further comprises a hydrogen-containing fuel, air, and combinations thereof.

Serial No.: 10/623,674

Docket No.: GMC0044PA/40320.48/GP-303298

23. (Canceled)

24. (Currently amended) A fuel processor based fuel cell system according to claim 21

wherein the superheated reactant stream ~~superheated in the superheat heat exchanger and~~
~~then~~ combined with compressed air is further combined with and a hydrogen-containing
fuel before being used in the primary reactor.

25. (Original) A fuel processor based fuel cell system according to claim 21 further

comprising a water gas shift (WGS) reactor provided in fluid communication with the
primary reactor, a WGS heat exchanger in fluid communication with the WGS reactor,
and an optional final CO-polishing stage provided in fluid communication between the
WGS heat exchanger and the HT-PEMFC stack.

26. (Original) A fuel processor based fuel cell system according to claim 21 wherein anode
exhaust from the HT-PEMFC stack before entering into the combustor to be consumed is
preheated by an anode exhaust preheat heat exchanger ~~which~~ is adapted to receive heat
energy from combustor exhaust.

27. (Original) A fuel processor based fuel cell system according to claim 21 further

comprising a water injector used to put water into the reactant stream prior to entering
into the superheat heat exchanger in order to provide the required steam for the primary
reactor at startup.

Serial No.: 10/623,674

Docket No.: GMC0044PA/40320.48/GP-303298

28. (Currently amended) A fuel processor based fuel cell system comprising:

a reactant stream comprising steam;

a primary reactor adapted to generate a gaseous reformat using the feed inputs;

a high temperature proton exchange membrane fuel cell (HT-PEMFC) stack adapted to receive the gaseous reformat for generating electrical power, the HT-PEMFC stack being cooled by water and the steam being provided via water vaporization of the water in the HT-PEMFC stack;

a water gas shift (WGS) reactor in fluid communication between the primary reactor and the HT-PEMFC stack;

a primary reactor heat exchanger situated between the primary reactor and the WGS reactor to preheat the reactant stream;

a catalytic combustor; and

a superheat heat exchanger adapted to receive heat energy from the catalytic combustor to superheat provide additional preheating to the reactant stream, the superheated reactant stream is then combined with compressed air before being used in the primary reactor.

29. (New) A fuel processor based fuel cell system according to claim 16 wherein the HT-PEMFC stack has an anode stoichiometry in a preferred range of about 1.1 to about 1.2.

Serial No.: 10/623,674

Docket No.: GMC0044PA/40320.48/GP-303298

30. (New) A fuel processor based fuel cell system according to claim 18 wherein the primary reactor uses a ratio of atomic oxygen in air flow to carbon in fuel flow (O:C) in a preferred range of about 0.75 to about 0.8.